

A solution to lake eutrophication

A Scion Impact Statement 2008

“Time bomb threatens lakes” a headline from the New Zealand Herald on Wednesday 13 August, 2008. *“A Danish water quality expert has warned that degradation of the country’s lakes is likely to get worse because a “time bomb” of polluting nitrates exists in the ground water. Erik Jeppesen, from Denmark’s National Environmental Research Institute, said years of intensive farming in New Zealand meant high concentrations of nitrogen and phosphorous would continue leaching into lakes and waterways for several decades yet.”*



A product used in kitty litter offers a new way of cleaning up Rotorua’s lakes – thanks to Scion. Zeolite, a mineral mined near Rotorua, has long been used to absorb moisture, oil, odours and removal of ammonia from water. A modified version of this versatile mineral developed by Scion has been successfully tested in a major trial to reduce eutrophication in Lake Okaro, one of the Rotorua region’s iconic lakes. The first major trial saw the Lake Trophic Index reduce from 5.9 to the targeted 5.0 which brings the lake back to a useable status.

Environment Bay of Plenty Rotorua Lakes Programme Manager Andy Bruere says the positive trial results are great news not only for Rotorua, but for all New Zealanders as water pollution caused by septic tanks, fertilisers and farm run-off is increasingly becoming a nationwide problem.

“Algal booms are formed as a direct result of the high levels of nutrients, such as phosphorus, in our lakes,” Andy says. *“Environment Bay of Plenty has invested in this full-scale lake trial as part of a wider lakes management strategy, including a proposed \$25 million sediment capping project targeted at Lake Rotorua, so to see such positive results is a fantastic outcome for everyone. “Given these most recent results, we hope to see a significant improvement in Lake Okaro water quality in the next two to three years, without the need for further intervention.”*

And this is just the beginning.

The water quality of the Rotorua lakes is a serious concern to sustainable development in the region. These lakes are internationally renowned for the recreational opportunities they offer, and have for many years underpinned the green tourist brand of the region. Lake Okaro is one of the region’s smaller lakes; it is very popular for recreational use, in particular with water skiers. It has also been subject to algal blooms every summer for many years. The Lake Okaro catchment is surrounded by dairy, sheep, beef and deer farms. The landowners and Environment Bay of Plenty have together developed a Lake Okaro Action plan¹. The plan’s immediate goal was to reduce the Trophic Index Level (TLI) from 5.9 to 5. A TLI above 5 means the lake is hypertrophic. Essentially the trophic state is a measure of the biological activity of the water and measures the total nitrogen, phosphorous, water clarity and chlorophyll. At a high trophic state, the water becomes subject to algal blooms.

¹ www.ebop.govt.nz

Environment Bay of Plenty (EBoP), with Scion and Scion's commercial partner, Blue Pacific Minerals, the zeolite mining company, have conducted two major trials. The aim of these trials was to use the modified zeolite to test its ability to cap phosphorous releases from the lakebed sediments. The first was a sighter trial using one tonne of the modified zeolite to prove the concept. It gave all parties confidence to move to a full-scale trial and, accordingly, in September 2007 some 112 tonnes of modified zeolite was dosed in the lake. The outcome was a 73% reduction in phosphorous (target was 50% reduction) and the TLI was reduced from 5.9 to 5, exactly on target.

Scion's development is essentially an alumino-silicate mineral coated with an aluminium polymer that has the capacity of binding to anionic pollutants such as phosphate. Zeolites are naturally occurring thermally modified clays. A hydrated alumino-silicate mineral with a microporous structure, they are formed through interactions between volcanic rocks and ash layers with alkaline ground water. The Rotorua region is a classic area to find such materials. Zeolite has an open and ordered crystalline structure with a very high surface-to-volume ratio and chemical reactivity that makes them ideal for absorbing odours, hence their widespread application in products such as kitty litter and removing the taint of ammonia from water.

Scion's development has introduced an application for zeolite in preventing internal nutrient recycling of phosphate from lakebeds by acting as a sediment cap in water bodies that are undergoing eutrophication, such as are found in the Rotorua lakes.

This project was initiated when Scion was approached by one of its post-doctorate employees who had been working on modifying zeolites. The synergy between their discovery and the EBoP need to reduce lake eutrophication was immediately noted. A partnership between Scion, EBoP and Blue Pacific Minerals, was established soon after in 2006 to take this idea to application. At this time, the product was still at a concept level. With a financial commitment from EBoP and BPM, the above team secured Pre-seed Accelerator Funding from Scion's devolved pre-seed fund and moved rapidly to scale-up the process. Mesocosm studies provided good early indicators that the concept would work, and soon after a one-tonne dosing study was undertaken in Lake Okaro.



Andy Bruere, EBoP Lakes Manager, advised the Rotorua Lakes Committee: Dosing of Lake Okaro with Z₂ the flocculent stock had taken place and continued monitoring of the water supply confirmed that Health Department standards had been met. The Committee acknowledged those who had worked to bring about the impressive drop in phosphorus release in Lake Okaro for the 2007/08 summer. Results were again promising and, due to urgency, EBoP were keen to move to full-scale trials. This required a substantial financial commitment from them, but their faith in the team and the process was justified, with a successful lake trial undertaken in September 2007. The targets for water quality were exceeded.

EBoP now has a solution that they will further seek to utilise. BPMs also have an opportunity to make a step-change growth in their company with international export opportunities in front of them.

Following the success of the first ever full lake trial, Blue Pacific Minerals Managing Director Dave Hill says the company is exploring opportunities to commercialise the product.

"We think the modified product provides local and national governing bodies with another tool that will help them achieve their objective to clean up New Zealand's waterways. Whilst clean-up plans differ depending on the nature of the pollution, the modified zeolite definitely supports goals to manage nutrients."